

What is Claimed Is:

1. A portable range extender for an electric vehicle having a vehicle controller, and an electric traction motor powered by a battery, the portable range extender comprising:  
an engine,  
a dynamoelectric machine coupled to the engine by a shaft and electrically connectable to the vehicle, and  
a range extender controller for controlling operations of the range extender independently of the vehicle controller, the range extender controller monitoring voltage of the battery to automatically activate the range extender when the battery voltage is less than a first threshold value and automatically deactivate the range extender when the battery voltage reaches a second threshold value.
2. The portable range extender of claim 1, wherein the range extender further comprises a battery voltage sensor for sensing the battery voltage.
3. The portable range extender of claim 1, wherein the range extender controller is configured to delay activating the range extender by a predetermined waiting period in response to detecting that the battery voltage is less than the first threshold value,.
4. The portable range extender of claim 3, wherein the range extender controller is configured to activate the range extender if after the predetermined waiting period the battery voltage is less than the first threshold value.
5. The portable range extender of claim 1, wherein the range extender further comprises a mode selection circuit for selecting between an automatic operating mode and a manual operating mode.

6. The portable range extender of claim 5, wherein in the automatic mode, the range extender is automatically activated when the battery voltage is less than the first threshold value and is automatically deactivated when the battery voltage reaches the second threshold value.

7. The portable range extender of claim 6, wherein in the manual mode, the range extender is manually activated by a user and automatically deactivated when the battery voltage reaches the second threshold value.

8. The portable range extender of claim 5, wherein in the manual mode, the range extender is not activated automatically when the battery voltage is less than the first threshold value.

9. The portable range extender of claim 1, wherein the engine is automatically turned on when the battery voltage is less than the first threshold value.

10. The portable range extender of claim 9, wherein the range extender controller is configured to operate the dynamoelectric machine as a motor for starting the engine when the battery voltage is less than the first threshold value.

11. The portable range extender of claim 10, wherein the range extender controller is responsive to prescribed engine conditions to operate the dynamoelectric machine as a generator driven by the engine to generate electrical power supplied to the vehicle.

12. The portable range extender of claim 10, wherein the engine is automatically turned off when the battery voltage reaches the second threshold value.

13. The portable range extender of claim 11, further comprising a power conversion circuit controlled by the range extender controller to operate as an inverter to convert DC power supplied by the battery to AC power required to operate the dynamoelectric machine as a motor for starting the engine.

14. The portable range extender of claim 13, wherein the power conversion circuit is controlled by the range extender controller to operate as a converter to convert AC power generated by the dynamoelectric machine into DC power supplied to the battery.

15. A range extender for an electric vehicle having an electric traction motor powered by a battery, the range extender comprising:

an engine,

a dynamoelectric machine structurally coupled to the engine by a shaft and electrically connectable to the vehicle,

a battery voltage sensor for sensing voltage of the battery, and

a controller responsive to the sensed voltage battery for delaying activation of the range extender by a predetermined waiting period when the battery voltage decreases below a first threshold value.

16. The range extender of claim 15, wherein the controller is configured to automatically activate the range extender if the battery voltage is less than the first threshold value after the predetermined waiting period.

17. The range extender of claim 16, wherein the controller is configured to

automatically deactivate the range extender when the battery voltage reaches a second threshold value.

18. A portable range extender for an electric vehicle having an electric traction motor powered by a battery, the portable range extender comprising:

an engine,

a dynamoelectric machine structurally coupled to the engine by a shaft and electrically connectable to the vehicle,

a mode selection circuit for selecting between an automatic operating mode and a manual operating mode, and

a range extender controller for controlling operations of the range extender independently of operation of the traction motor, wherein

in the automatic mode, the range extender controller monitors voltage of the battery to automatically activate the range extender when the battery voltage is less than a first threshold value and automatically deactivate the range extender when the battery voltage reaches a second threshold value, and

in the manual mode, the range extender is activated by a user but is automatically deactivated when the battery voltage reaches the second threshold value.

19. A method of controlling a range extender for an electric vehicle having an electric traction motor powered by a battery, the range extender comprising an engine, and a dynamoelectric machine coupled to the engine, the method comprising the steps of:

sensing voltage of the battery,

in response to the sensed battery voltage decreasing below a first threshold value, operating the dynamoelectric machine as a motor for starting the engine, and

in response to a prescribed engine condition, operating the dynamoelectric machine as a generator driven by the engine to generate electrical power supplied to the vehicle.

20. The method of claim 19, further comprising the step of automatically turning off the engine when the sensed battery voltage reaches the second threshold value.

21. The method of claim 19, wherein in response to the sensed battery voltage decreasing below a first threshold value, the step of operating the dynamoelectric machine as a motor for starting the engine is delayed by a first predetermined period.

22. The method of claim 21, further comprising the step of sensing the battery voltage at the end of the first predetermined period to operate the dynamoelectric machine as a motor for starting the engine if the battery voltage is less than the first threshold value.

23. A method of controlling a range extender for an electric vehicle having an electric traction motor powered by a battery, the method comprising the steps of:

sensing voltage of the battery at a first moment of time,

if the battery voltage is less than a first threshold value, sensing the battery voltage again after a predetermined waiting period, and

if the battery voltage is less than the first threshold value after the predetermined waiting period, automatically activating the range extender.

24. The method of claim 23, further comprising the step of automatically deactivating the range extender when the battery voltage reaches a second threshold value.